USING IT FOR PATIENT-CENTERED COMMUNICATION AND DECISION MAKING ABOUT MEDICATIONS

FINAL REPORT

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ABSTRACT

OBJECTIVE: We leveraged an electronic health record (EHR) to improve medication management and patient understanding to enhance patient-centered communication and decision making in primary care.

METHODS: We field tested: 1) a patient-initiated medication reconciliation strategy to reduce discrepancies in EHR medication lists (N=319), 2) a health literacy intervention to provide plain language information to support safe, appropriate use (N=413). Both were incorporated into the Epic HER (Verona, WI). The study design was the same for each: a pre-test assessment was conducted prior to implementation, and patients were randomized to intervention or usual care during a post-test period. Outcomes were: presence of a medication discrepancy post-visit, reconciliation, physician-patient communication around new medications, understanding of new prescriptions, and adherence.

RESULTS: Those receiving the intervention were more likely to have medication reconciled by 6 weeks post visit compared to usual care (49% v. 31%, p=0.15), with omission discrepancies being reconciled nearly 7 fold more likely in the intervention arm compared to usual care (46% v. 8%, p=0.06). In multivariable analyses, discrepancies that were linked to medicines that were prescribed by other doctors (Odds Ratio (OR) 2.91, 95% Confidence Interval (CI) 1.48 – 5.76), over-the-counter (OR 4.40, 95% CI 2.37 - 8.17), or commissions (OR 7.44, 95% CI 3.61 – 15.34) were less likely to be reconciled. For Study 2, no significant differences were noted in likelihood of having discussed new medicines.

CONCLUSION: These EHR tools proved to be a feasible strategy that could be an efficient and sustainable means for reconciliation and education.

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A. PROJECT SCOPE

OBJECTIVE **To improve medication management and patient understanding by using information technology to enhance patient-centered communication and decision making in primary care.**

Patient-centered care is based on establishing effective partnerships in which communication and decision making are informed by the clinician's expertise, experience, and access to evidence as well as the patient's needs, knowledge, values, and abilities. In the ambulatory setting, the process of medication management is truly a meeting between experts: Physicians are patients' primary source of information about medications, while patients have the best perspective on how treatment plans fit into their own lives and are the best source of information about medication lists, adherence, experience (e.g., side-effects), and obstacles (e.g., cost).

However, prior studies have shown that patient-provider communication about medications is inadequate. Patients tend to have a limited understanding of medication instructions and warnings, and are often uncertain about side-effects. Moreover, ineffective communication and decision making may be one reason that many prescriptions go unfilled or unused. In addition, discrepancies between medication lists and actual use are common and have a detrimental impact on patient safety. Previous studies have not included patients in systematic efforts to redesign the process of reviewing current medications and discussing new medications.

This project brings together four vibrant lines of research and development at Northwestern: patient-provider communication, health literacy, medication safety, and informatics. With patient input, we developed an innovative, electronic health record (EHR) strategy to improve patient-centered communication and informed decision making about medications. Our efforts to streamline and transform practice have the ultimate goals of improving patient knowledge, safety, and satisfaction as well as clinician accuracy, efficiency, and satisfaction.

The patient-centered information technology interventions in this study were designed to enhance clinician-patient communication and shared decision making about medications, with a focus on increasing patient understanding of essential information and improving the medication therapy management process. What we devised – each component - was specifically chosen based on the ability to be rapidly adapted and disseminated to any practices that use an EHR (not just Epic, which is used here).

Our **SPECIFIC AIMS** were to:

Aim 1 Pre-Visit Patient Intervention: Develop and test a DVD multimedia program to help patients understand the importance of both giving and receiving accurate information about medications.

Aim 2 Provider/System Intervention: Use the EMR to encourage patient-centered medication management.

- **Aim 2A** Extend the EMR medication management capability by training nurses to engage in a patient-centered review of *current medications* immediately before a patient sees the doctor.
- **Aim 2B** Leverage the EMR by developing a template that physicians can easily access and display on-screen to engage in a patient-centered discussion about *new medications* under consideration.

Aim 3 Disseminate and track the use of effective interventions, and create pathways for facilitating national distribution to other practices.

Modifications to Original Aims

As described previously in quarterly progress reports, our original AIM 1 was modified as a result of in situ learning about the changing processes of care in our performance site. Specifically, the time from scheduling an appointment (patient-initiated) to the actual clinical encounter was < 5 days. This period of time was too short to mail a DVD background video. Similarly, use of our patient portal within Epic (MyChart) was and continues to remain low, despite higher levels of new registration. Our team therefore to develop a print general medication management educational tool (MyMeds Folder) that would be provided at the time of the encounter.

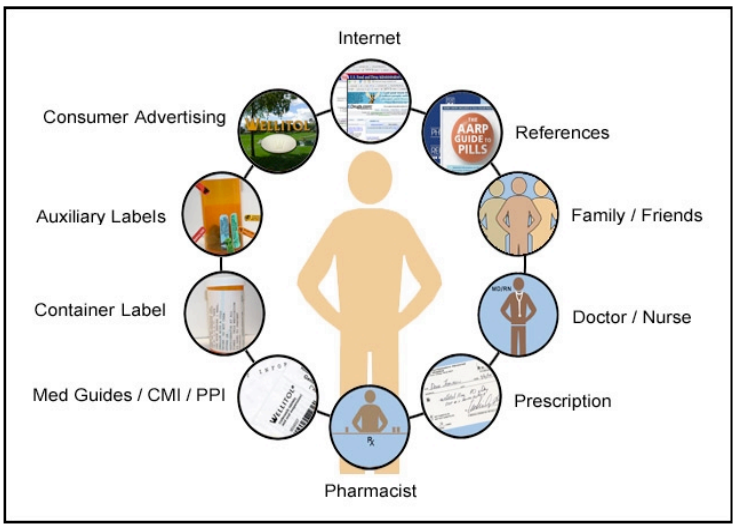
CONTEXT

People are constantly making decisions about their health (e.g., whether to see their physician about a health problem; what to bring up during an encounter; whether to follow the physician's advice). A major factor in enabling patients to increase control over their health involves developing their competencies for making decisions and enacting behaviors that can lead to desired and attainable health outcomes. With regard to the medical encounter, patients can maintain control by obtaining information about their situation and participating in decisions about treatment. Focusing on medication management is critical because whether and how to use prescription medications are among the most common and important decisions in which patients can participate.

Patient-centered care is based on establishing effective partnerships in which communication and decision making are informed by the clinician's expertise, experience, and access to evidence as well as the patient's needs, knowledge, values, and abilities. A recent critical review of patient-centeredness by de Haes concludes that activating patients and addressing patient perspectives (e.g., problems, questions, concerns) are broadly applicable and viable aspects of patient-centered care, the hypothesized benefits of which can be tested empirically. In the ambulatory setting, the process of medication management is truly a meeting between experts: Physicians are patients' primary source of information about medications, while patients have the best perspective on how a treatment plan fits into their own lives and are the best source of information about medication lists, adherence, experience (e.g., side-effects), and obstacles (e.g., cost). Although physicians are patients' preferred and main source of information about prescription medications, communication and decision making have repeatedly been found to be inadequate.

Figure 1 illustrates that the spectrum of medication information neither begins nor ends at the moment physicians give prescriptions to their patients. In the event a patient leaves the physician's office without the knowledge needed to implement the prescribed regimen, the pharmacist would be next in line to provide counseling at the point of dispensing medicines. Studies have shown that pharmacists do not oftenorally communicate information to patients to support compliance with treatment plans. Thus, patients are left to digest medication information in print format (e.g., container label, consumer medication information, medication guides, patient leaflets), which are difficult to comprehend and use, regardless of literacy level.

Figure 1. Sources of Patient Rx Information.



Without clear information from formal sources, individuals may interact with informal sources to learn about their medicines. Indeed, Stein and colleagues found that patients received very little information from healthcare staff regarding their treatment, but worked to find knowledge from other sources which may or may not be reliable. Such sources might include social networks (e.g., family, informal caregivers, friends), the Internet and other reference materials, or even Direct-to-Consumer advertising for various drugs. These sources can be highly problematic: It is often difficult to ascertain the quality, accuracy, or readability of the information. This situation highlights the need for both verbal and written information that comes from the provider. National Patient Safety Goals for 2007 include encouraging patients' active involvement in their own care. Interventions are needed to activate patients by helping them understand what they can expect from medications, and reinforcing the importance of giving and receiving clear information about medications.

SETTING

The primary performance site for this project was Northwestern University; specifically the Northwestern Medical Faculty Foundation (NMFF) Division of General Internal Medicine (GIM) ambulatory clinics. NMFF GIM is a multispecialty faculty practice, with attending 40 physicians (88 residents) who practice full or part time. The clinic is organized into four areas ("pods") with separate nursing staff and physicians, creating an ideal environment for controlled clinical trials randomized at the pod level. For dissemination, pilots were conducted at St. Francis Community Hospital in Hartford, CT. The original dissemination site was North Shore general medicine practices in Evanston, IL. However, during the grant period, these sites parted ways with Evanston-Northwestern Healthcare, and Dr. Gregory Makoul, the original principal investigator for this project, left Northwestern University for St. Francis. Our longstanding collaboration with Dr. Makoul made it possible for us to extend to a new site (Cerner) for dissemination.

PARTICIPANTS

Participants include both NMFF GIM patients (adults 18 and over) for one of two studies: medication reconciliation (STUDY 1; those patients with five or more medicines), and new prescriptions (STUDY 2). In addition, participants in the intervention development and refinement process included NMFF GIM medical staff, nursing staff, administration, clerical staff, and Northwestern Memorial Hospital pharmacy staff. In addition, we involved NMFF Information Technology to provide guidance, support, programming, and trouble shooting for the EHR tools implementation. Other stakeholders included additional subspecialty practices at Northwestern, patients and families who provided thoughtful comment on our tools and processes throughout this implementation period.

INFORMATION TECHNOLOGY (IT) ENVIRONMENT

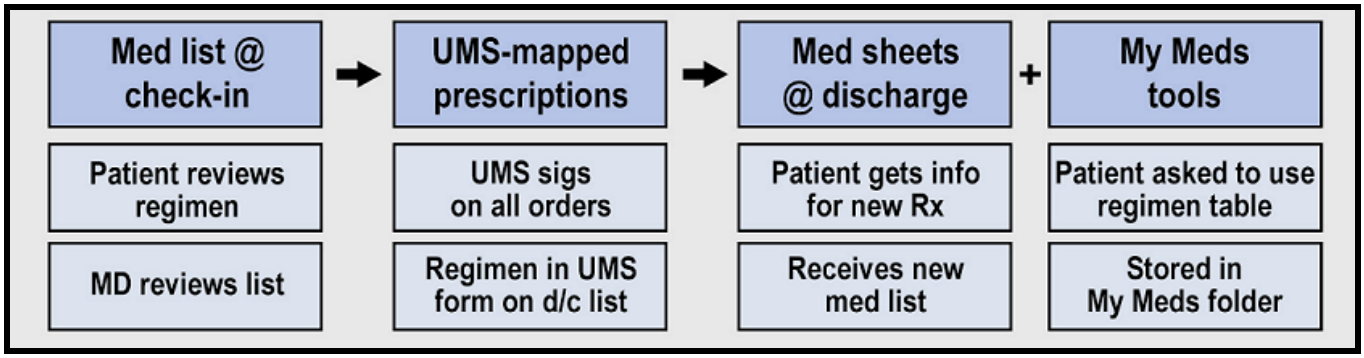
All GIM physicians use the Epic EHR (Epic Systems Corporation; Verona, Wisconsin) for all clinical encounters (in-person and telephone). The GIM clinic was an early adopter of the EHR: Initial use of Epic in NMFF started in 1995 with a handful of general internists as part of a National Library of Medicine demonstration project/research study. In 2001, NMFF began implementing Epic throughout the organization. Currently, all of our clinical practices use the EHR and all NMFF physicians are using Computerized Physician Order Entry (CPOE) with electronic documentation. Overall, there are approximately 1950 Epic users including nurses and clerical staff. NMFF goals of using an EHR include enhancing patient safety, improving quality of care, and increasing physician efficiency. Advantages to using Epic for medication management include improving legibility and organization of medications, reducing medication dosing errors, and leveraging medication interaction databases.

The EpicCare Ambulatory EHR is certified by the Certification Commission for Healthcare Information Technology (CCHIT) and Epic Systems Corporation is a member organization within the Health Information Technology Standards Panel (HITSP). Epic Systems Corporation has consistently received national accolades. In an annual survey by research firm KLAS Enterprises, CIOs, executives, managers, and clinicians representing over 4,000 healthcare facilities recognized Epic Systems Corporation as the Best Vendor Overall, and Best in KLAS for Ambulatory EMR for four years running. Northwestern University has a track record of co-development efforts with Epic Systems Corporation. Elements of the current Epic product, including Best Practices Alerts and template-driven progress notes, are a direct result of a $2.3 million National Library of Medicine sponsored collaboration between Northwestern University and Epic Systems Corporation. Both Northwestern University and Evanston Northwestern Hospital have won the Davies Award of Excellence for Healthcare Organizations for their rapid and effective deployment of an Electronic Health Record (Epic).

In light of the Health Information Technology for Economic and Clinical Health (HITECH) Act and the efforts of the Office of the National Coordinator for Health IT, we continue to expand our use of Epic for patient decision support. Of note, during the time of this application electronic prescribing (e-prescribing) was rolled out in NMFF GIM clinics. This provided additional opportunities as a 'natural experiment' within our baseline assessment to examine the impact of e-prescribing on clinic processes and patient outcomes.

B. METHODS

The overall goal of this project was to improve both medication reconciliation and likelihood of a comprehensive medication review during medical encounters, and to better inform patients on safe, appropriate use for newly prescribed medications. In all, the goal was to improve both safety and adherence via EHR tools and more clear, understandable communication with providers and informed decision making. The general model is represented below for patient flow through NMFF GIM:



Study 1 activities target the Med List review and reconciliation, while Study 2 represents the Med Sheets, Universal Medication Schedule (UMS) 'sigs' for After-Visit Summary as well as a general educational tool, called the MyMeds folder. All of these are described below.

STUDY DESIGN

We used the same design framework for evaluating both reconciliation and education activities, although in two separate samples. Thus, we refer to these as Study 1 and Study 2. Note: Study 1 was meant to address the outcome of reconciliation of discrepancies in the medication list by activating patients to review their medication list prior to an encounter and to work with the physician to remove or reconcile these issues. Study 2 focused on education for new prescription medicines. In either case, we conducted 1) a **baseline assessment** among eligible patients, per study criteria, 2) allowed for a brief implementation and troubleshooting period for EHR tools to be turned on and assessed to confirm

functionality/fidelity, and 3) a post-intervention assessment wherein patients were randomized to either intervention or control. This was done by randomizing attending physicians to have the various functions for either study turned on or off within their preference list.

SAMPLE & RECRUITMENT

Study 1: Patients were deemed eligible if they were 1) English-speaking, 2) without cognitive, vision, or hearing impairment to a degree in which they could not interact with the survey, 3) without any significant, acute health condition, 4) between the ages of 18-80, and 5) were taking 5 or more chronic, prescription medications that would qualify for the need for medication therapy management (as they would be considered as having a complex drug regimen).

Study 2: Patients were deemed eligible if they were 1) English-speaking, 2) without cognitive, vision, or hearing impairment to a degree in which they could not interact with the survey, 3) without any significant, acute health condition, 4) between the ages of 18-80, and 5) received one or more new prescription medications on the day of recruitment.

Recruitment. For both studies, flyers were distributed across the clinic site, clerical and medical staff were made aware of the project, and project coordinators themselves were in the clinic during high volume periods to invite participants deemed eligible (via medical, nursing, or clerical staff) to the study. Recruitment for both Study 1 and Study 2 ran parallel for baseline assessment activities, but then Study 1 intervention tools were turned on first, then Study 2 followed.

STUDY 1 INTERVENTION: MEDICATION RECONCILIATION

Attending physicians (n=25), nurses (n=7), and clerical staff (n=3) at the internal medicine practice were all consulted via iterative discussion groups to document the current workflow in detail. It was deemed necessary by the practice administration and clinical faculty alike that any medication reconciliation effort, for it to be sustainable, should not significantly add time or tasks to staff. Further, plans for contacting patients prior to appointments also was ruled out, as the average time between scheduling an appointment and the medical encounter was reported at < 5 days, and the EHR patient portal usage was very low. Therefore, the approach taken was to activate patients as they came for their medical appointment to review their medication list while in the clinic waiting room.

Figure 2. Sample Medication Reconciliation Form.

Zztest, Becky (MR # Z9Z)

Please Review Your Medicines

It is very important that your doctor knows all the medicines you are taking.

Follow these steps:

Step 1. Remove any medicines you are not currently taking by **drawing a line through the drug's name**.

Step 2. For medicines you are currently taking, place a check (√) in the **Taking as directed?** column next to the correct box indicating if you are taking the medication as described in the instructions.

Step 3. Place a check (√) in the **Concerns** column next to any concern you may have about the medication.

Your Current Medications Are

Medication	Instructions	Taking as directed?	Concerns
CELEBREX 200 MG OR CAPS	Take one tablet by mouth daily with food	☐ yes ☐ no ☐ taking only as needed	☐ None ☐ Need Refill ☐ Cost ☐ Side Effects ☐ Other
DONEPEZIL HYDROCHLORIDE (ARICEPT) 5 MG TABS	Take one tab by mouth every AM	☐ yes ☐ no ☐ taking only as needed	☐ None ☐ Need Refill ☐ Cost ☐ Side Effects ☐ Other
TYLENOL 325 MG TABS	2 TABLETS EVERY 4 HOURS AS NEEDED	☐ yes ☐ no ☐ taking only as needed	☐ None ☐ Need Refill ☐ Cost ☐ Side Effects ☐ Other
ZIAC 5-6.25 MG or TABS	1 TABLET DAILY	☐ yes ☐ no ☐ only as needed	☐ None ☐ Need Refill ☐ Cost ☐ Side Effects ☐ Other
ZOLPIDEM TARTRATE (AMBIEN) 10 MG TABS	Take one tab by mouth every night	☐ yes ☐ no ☐ taking only as needed	☐ None ☐ Need Refill ☐ Cost ☐ Side Effects ☐ Other

Within Epic, a medication reconciliation tool (MRT) was created from patients' current medication lists (see Figure 2). When a patient checked in at the front desk for their appointment, the clerk at the clinic would enter their name in Epic, which would then automatically generate the MRT and print it out at the clerk's station. The MRT would be handed to the patient with no further instruction. Rather, plain language, explicit, and actionable steps written at the 7th grade level guided the patient through the medication list review and reconciliation process. The patient was asked to: 1) review the list of medicines and cross off any medicines they were not taking, 2) for each medication, to check off using simple boxes next to each, whether they were taking as directed (yes, no, as needed) or if they had concerns

for costs, side effects, refills, or other, and if they wanted the doc tor to review this medicine with them, 3) add any prescription medicines they are taking that are not on the list, and 4) add any over-the-counter drug, vitamin, or herbal supplement that they take on a regular basis.

Patients were expected to complete the MRT while in the waiting area, and the final instruction on the form told them to take the form with them back to the exam room and hand it to their doctor. The expectation was that the MRT would serve as the 'signal' for physicians that alerted them to engage in the comprehensive medication review process with the patient. The simple, structured MRT template would expedite the reconciliation process by easily displaying whether there were any discrepancies, by omission or commission, to address. Further, adherence-related concerns could also be highlighted for discussion. Figure 2 presents a patient flow chart for the intervention and evaluation.

STUDY 2 INTERVENTION: ENHANCED COMMUNICATION FOR NEW PRESCRIPTIONS

Using the same strategy as Study 1, we consulted medical, nursing, and pharmacy staff to gain feedback on a prototype for providing clear, understandable, actionable patient medication information on a 1-page sheet that would be generated with the Epic After-Visit Summary automatically with new or changed physician orders. Content topics were vetted and approved by the study team, including clinicians (physicians, nurses, pharmacists), health literacy experts, and two patient representatives. The top 500 prescribed medicines for NMFF GIM were reviewed, and 'Med Sheets' were developed following an approved template. The process involved a pharmacist, 2 physicians, 2 health literacy and health communication experts reviewing and revising drug content per category (see sample in Figure 2) and confirming accuracy via existing content sites (FDA, drugs.com, National Library of Medicine). An outside panel of 3 pharmacists and 1 physician did a final review.

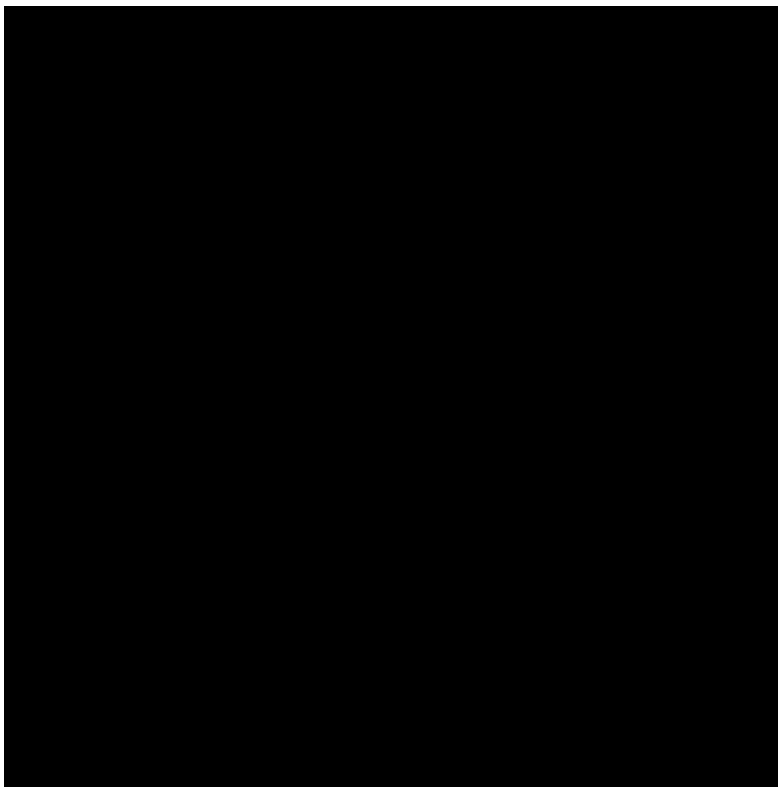
Table 1. List of the 305 Prescription Medications included in Study 2 (Med Sheets Developed).

Acetaminophen-Codeine	Clindamycin HCl	Gemfibrozil	Mesalamine-Cleanser	Progesterone
Acyclovir	Clindamycin-Benzoyl Per-Cleans	Gentamicin Sulfate	Metaxalone	Promethazine HCl
Adapalene	Clobetasol	Glimepiride	MetFORMIN HCl	Promethazine-Codeine
Albuterol	ClonazePAM	GlipiZIDE	Methadone	Promethazine-DM
Albuterol Sulfate	CloNIDine HCl	GlipiZIDE-MetFORMIN HCl	Methimazole	Propoxyphene N-APAP
Alendronate Sodium	Clopidogrel Bisulfate	GlyBURIDE	Methocarbamol	Propranolol HCl
Allopurinol	Clorazepate Dipotassium	GlyBURIDE-MetFORMIN	Methylphenidate	Pseudoephedrine-Guaifenesin
ALPRAZolam	Clotrimazole	Guaifenesin-Codeine	MethylPREDNISolone	Quinapril HCl
Amiodarone HCl	Clotrimazole-Betamethasone	HydrALAZINE HCl	Metoclopramide HCl	QuiNINE Sulfate
Amitriptyline HCl	Colchicine	Hydrochlorothiazide	Metolazone	Rabeprazole Sodium
Amlodipine Besy-Benazepril HCl	Conj Estrog-Medroxyprogest Ace	Hydrocodone-Acetaminophen	Metoprolol Succinate	Raloxifene HCl
AmLODIPine Besylate	Cyclobenzaprine HCl	Hydrocodone-Guaifenesin	Metoprolol Tartrate	Ramipril
Amoxicillin	Desloratadine	Hydrocodone-Ibuprofen	Metronidazole	Ranitidine HCl
Amoxicillin-Pot Clavulanate	Desloratadine-Pseudoephedrine	Hydrocortisone	Minocycline HCl	Risedronate Sodium
Amphetamine salts	Desogestrel-Ethinyl Estradiol	Hydroxychloroquine Sulfate	Mirtazapine	Rosiglitazone Maleate
Aspirin	Dexamethasone	HydrOXYzine HCl	Modafinil	Rosiglitazone-Glimepiride
Atenolol	Diazepam	Hyoscyamine	Moexipril HCl	Rosiglitazone-Metformin
Atenolol-Chlorthalidone	Diclofenac Sodium	Ibandronate Sodium	Mometasone Furoate	Rosuvastatin Calcium
	Dicyclomine HCl	Ibuprofen	Montelukast Sodium	Salmeterol Xinafoate
Atorvastatin Calcium		Imipramine HCl	Morphine Sulfate	Sertraline HCl
AzaTHIOprine	Diltiazem HCl	Indapamide	Moxifloxacin HCl	Simvastatin
Azelastine HCl	DiphenhydrAMINE HCl	Indomethacin	Mupirocin	SitaGLIPtin Phosphate
Azithromycin	Diphenoxylate-Atropine	Indomethacin Sodium	Nadolol	SitaGLIPtin-MetFORMIN HCl
Baclofen	Divalproex Sodium	Insulin Aspart	Naproxen Sodium	Sodium Fluoride
Benazepril HCl	Docusate Calcium	Insulin Aspart Prot & Aspart	Niacin	Sotalol HCl
Benazepril-Hydrochlorothiazide	Dorzolamide-Timolol	Insulin Detemir	NIFEdipine	Spironolactone
Benzonatate	Doxazosin Mesylate	Insulin Glulisine	Nitrofurantoin	Sulfamethoxazole-Trimethoprim
Benztropine Mesylate	Doxepin HCl	Insulin Human	Nitroglycerin	Tamoxifen Citrate
Bimatoprost	Doxycycline (Rosacea)	Insulin Isophane & Regular	Norelgestromin-Eth Estradiol	Telmisartan
Bisoprolol Fumarate	Drospirenone-Ethinyl Estradiol	Insulin Isophane Human	Norethindrone Acet-Ethinyl Est	Telmisartan-HCTZ
Bisoprolol-Hydrochlorothiazide	Enalapril Maleate	Insulin Lispro (Human)	Norethindrone-Eth Estradiol	Temazepam
Brimonidine Tartrate	Erythromycin	Insulin Lispro Prot & Lispro	Norgestimate-Ethinyl Estradiol	Terazosin HCl
Budesonide	Escitalopram Oxalate	Insulin Regular Human	Norgestrel-Ethinyl Estradiol	Terbinafine
Budesonide-Formoterol Fumarate	Esomeprazole Magnesium	Ipratropium Bromide	Nortriptyline HCl	Tetracycline
Bumetanide	Estradiol	Ipratropium-Albuterol	Nystatin	Theophylline
BuPROPion HCl	Estradiol-Levonorgestrel	Irbesartan	Nystatin-Triamcinolone	Thyroid
BuPROPion HCl (Smoking Deter)	Estrogens, Conjugated	Irbesartan-Hydrochlorothiazide	Olmesartan Medoxomil	Timolol
BusPIRone HCl	Ethinyl Estradiol	Isosorbide Dinitrate	Olmesartan Medoxomil-HCTZ	TiZANidine HCl
Butalbital-APAP-Caffeine	Etodolac	Isosorbide Mononitrate	Olopatadine HCl	Tobramycin
Calcitonin (Salmon)	Etonogestrel-Ethinyl Estradiol	Ketoconazole	Omeprazole	Tobramycin-Dexamethasone
Candesartan Cilexetil	Ezetimibe	Labetalol HCl	Oxcarbazepine	Topiramate
Captopril	Famotidine	Lactulose	OxyCODONE HCl	Torsemide
CarBAMazepine	Felodipine	LamoTRIgine	Oxycodone-Acetaminophen	TraMADol HCl

Carisoprodol	Fenofibrate	Lansoprazole	Pantoprazole Sodium	Tramadol-Acetaminophen
Carvedilol	FentaNYL	Latanoprost	PARoxetine HCl	Trandolapril
Cefadroxil	Ferrous Sulfate	Levalbuterol HCl	Penicillin V Potassium	Tretinoin
Cefdinir	Fexofenadine HCl	Levetiracetam	PHENobarbital	Triamcinolone
Cefprozil	Fexofenadine-Pseudoephedrine	Levofloxacin	Phentermine HCl	Triamcinolone Acetonide
Cefuroxime Axetil	Fluconazole	Levothyroxine Sodium	Phenytoin	Triamcinolone Acetonide(Nasal)
Celecoxib	Fluocinolone Acetonide	Lidocaine	Pioglitazone HCl	Triamterene
Cephalexin	FLUoxetine HCl	Lisinopril	Pioglitazone HCl-Glimepiride	Triamterene-HCTZ
Cetirizine HCl	FLUoxetine HCl (PMDD)	Lisinopril-Hydrochlorothiazide	Pioglitazone HCl-Metformin HCl	Triazolam
Cetirizine-Pseudoephedrine	Fluticasone Propionate	Lithium Carbonate	Piroxicam	Valacyclovir HCl
Chlorhexidine Gluconate	Fluticasone Propionate HFA	LORazepam	Polyethylene Glycol 3350	Valganciclovir HCl
Chlorpheniramine-Hydrocodone	Fluticasone-Salmeterol	Losartan Potassium	Polymyxin B-Trimethoprim	Valsartan
Chlorthalidone	Fluvastatin Sodium	Losartan Potassium-HCTZ	Potassium Chloride	Valsartan-Hydrochlorothiazide
Cimetidine	Fosinopril Sodium	Lovastatin	Pravastatin Sodium	Venlafaxine HCl
Ciprofloxacin HCl	Furosemide	Meclizine HCl	PrednisoLONE	Verapamil HCl
Citalopram Hydrobromide	Gabapentin	MedroxyPROGESTERone Acetate	PrednisONE	Warfarin Sodium
Clarithromycin	Ganciclovir Sodium	Meloxicam	Prochlorperazine	Zaleplon
Clidinium-Chlordiazepoxide	Gatifloxacin	Mesalamine	Prochlorperazine Maleate	Zolpidem Tartrate

'Best Practice Instructions'. Physician instructions, known as 'sigs' were also reprogrammed in Epic for Study 2. Specifically, our team has previously proposed and tested the efficacy of using a Universal Medication Schedule (UMS) to standardize the way instructions are provided to patients on how to take their medicine (see Figure 3). The UMS grounds medication-taking to four time periods (morning, noon, evening, bedtime) and uses simplified language and formatting to promote understanding (i.e. 'take 1 pill in the morning and 1 pill at bedtime' instead of 'take one tablet twice daily'). The UMS is designed to not only help patients better understand Rx instructions but also to organize and simplify Rx regimens. In total, patients would receive these simplified instructions on their After-Visit Summary, these sigs would also be transmitted to the pharmacy, and Epic would generate a Med Sheet for their new prescription at check-out.

MyMeds Folder. The final component of Study 2 was the replacement to the originally proposed DVD (Aim 1). A general folder to contain Med Sheets would be given to patients at check out that explains the salience of reviewing medications and concerns with providers, and what actions to take before, during, and after medical encounters.



RANDOMIZATION

Attending physicians were randomized to either the intervention or usual care arm by first stratifying them by clinical effort (number of clinic days), then randomly assigning physicians within each stratification (full time, half time, > half time) to study arm. A simple 1:1 randomization scheme could was not possible, as the EHR function could not

be applied at the individual patient level. Rather, Epic did allow us to turn on or turn off the MRT via user preferences. However, blinding was not possible since the presence of the generated medication lists would be apparent to clinicians during the medical encounter.

MEASUREMENT

For this evaluation, the unit of analysis was both patient and medication. Basic demographic, socioeconomic, and clinical characteristics were collected from patients (see Table 1). Patients' medications were classified as prescription (Rx) versus over-the-counter (OTC), drug class, and by prescriber (internal medicine attending or other). Three primary outcomes were assessed. There were two at the patient level; the prevalence of medication discrepancies between patient self-report and medical chart (yes or no) and whether any reconciliation activity occurred with a patients' medication list. At the medication level, the outcome was whether or not discrepancies were reconciled (yes or no).

Outcomes: Study 1. The presence of medication discrepancies was measured by looking at concordance in what patients self-report as medicines they are taking (using print-out of current EHR medication list as a prompt) and the medical record. Discrepancies were coded as either prescription or over-the-counter, omission or commission, and whether the medicine was prescribed by the physician in GIM or another outside provider. The drug class of each medication was also recorded. Medication reconciliation was noted in post-assessments, per medication, and considered if the discrepancy per medicine had been resolved post-encounter. Periods of study for reconciliation were classified as after visit, 2 weeks post visit (when visit is closed out), or 6 weeks post-visit. In addition, participants were asked if the doctor reviewed their medication list with them, and if they had questions about medicines that the physician did not answer.

Outcomes: Study 2. Patient understanding would be assessed by functional demonstration questions. This included, per new prescription, patients being asked what the medicine was for, how many pills would they take at a time, how many times a day they would take medicine, at what times of day would they take the drug, for how long, and to name as many side effects associated with the medicine. Primary adherence was measured by self-report via telephone call to see if they filled their prescription, and secondary adherence was considered as missed or wrong doses following the Patient Medication Adherence Questionnaire (PMAQ) items administered 1-2 weeks post filled prescription. Additional items were asked about whether the doctor reviewed medicines, mentioned how to take the medicine, side effects, or indication.

PROCEDURE

Trained project coordinators approached pre-identified patients presumed to be eligible by age, language, lack of impairment, number of medications recorded in medical record (STUDY 1), or the presence of a new prescription at check-out. Clinic staff provided patient-level detail and shared with research staff who were on site. Potentially eligible individuals were handed a general flyer with information about the study, and asked if they would be interested in learning more. If yes, they would be directed to the research staff. The interviewer would take the patient to a private interviewing room and confirm eligibility. After consent to the study, a brief battery of demographic, socioeconomic, and baseline health status items would be administered, along with a literacy assessment (Rapid Estimate of Adult Literacy in Medicine REALM).

For Study 1, medical records were reviewed at 2 weeks and 6 weeks post visit to check to see if discrepancies had been reconciled. For Study 2, a follow-up phone call would be conducted, to first see if the prescription had been filled, and if yes, a second call 1-2 weeks later which assessed the participants' understanding and adherence.

ANALYSIS PLAN

Study 1. Patient characteristics including age, sex, race/ethnicity, education, income, literacy level, number of comorbid conditions, and total number of prescription and OTC medications were summarized for both the Pre and Post-intervention groups. These characteristics were compared between the usual care and intervention groups using t-tests for continuous variables and Pearson Chi-Square tests for categorical variables. Generalized linear models with a binomial distribution and logit link function were used to first estimate the predictors of medication discrepancies at each of 3 time points (after visit, 2 weeks, and 6 weeks) followed by predictors of whether any discrepant medications were reconciled at 6 weeks. A generalized estimating equation (GEE) approach was used with medication as the unit of analyses, adjusting model coefficients and standard errors for within-patient correlation. The primary independent variable of interest for each set of models was arm (usual care, intervention) with usual care as the reference group. For the medication discrepancy outcome, independent variables included mediation type (OTC, Rx) and whether the medication was prescribed by the physician the patient saw that day or another physician. These variables were also included in the reconciliation models with the addition of discrepancy type (commission, omission). Interaction terms between arm and each of the covariates were examined to determine whether associations varied according to these characteristics. Statistical analyses were performed using STATA 11.2 (College Station, TX).

Study 2. Similar univariate and bivariate analyses were performed for Study 2 as mentioned for Study 1. What is reported here are assessments of fidelity, feasibility, and preliminary efficacy for the outcome of self-report of physician communication and patient understanding. Each of the outcome measures represent dichotomous variables, and chi square tests were used to examine differences by study arm. Adherence outcomes were viewed as exploratory and also treated as a binary variable with 80% or greater adherence in the past week (based on missed/wrong doses) viewed as the threshold. Filled prescriptions would be treated similarly, however too few patients had not filled prescriptions that this outcome is reported upon but not examined beyond e-prescribing data (Tables 9, 10).

C. RESULTS

Table 2 provides a summary of the sample size recruited, per study, for each phase.

Table 2. Project Recruitment

	Baseline	Post-Intervention		
		Total	Usual Care	Intervention
Study 1	175	144	69	75
Study 2	271	142	75	67

STUDY 1

Across both Pre and Post-Intervention periods, the demographics of the sample were similar (Table 3). For the intervention trial post-implementation of the MRT, patients linked to the randomized physicians differed only by race, with nearly 2-fold more African American patients being seen by control physicians.

Table 3. Characteristics of Participants, by Study Period and Arm.

Variable	Pre-Intervention	Post-Intervention			
		Total	Usual Care	Intervention	P Value
	(N=175)	(N=144)	(n=69)	(n=75)	
Age, M (SD)	60.3 (12.8)	60.5 (13.9)	59.4 (12.7)	61.5 (14.9)	0.39
Female, %	74.9	70.1	75.4	65.3	0.20
Race/Ethnicity, %					
Black	40.0	42.4	56.5	29.3	0.003
White	49.1	44.4	36.2	52.0	
Other	10.9	13.9	7.3	18.7	
Education, %					
≤ High School	25.1	18.8	20.3	17.3	0.74
Some college	35.4	31.3	33.3	29.3	
≥ College Graduate	39.4	50.0	46.4	53.3	
Literacy Level, %					
Low	8.1	7.1	5.8	8.3	0.45
Marginal	22.1	19.2	23.2	15.3	
Adequate	69.8	73.8	71.0	76.4	
Annual Income, %					
< $15,000	33.1	29.9	36.4	23.9	0.30
$15,000-$49,999	31.3	34.3	31.8	36.6	
≥ $50,000	35.6	35.8	31.8	39.4	
# Comorbid conditions, M (SD)	2.6 (1.4)	2.5 (1.4)	2.6 (1.4)	2.4 (1.5)	0.40
# Rx medications taken, M (SD)	8.0 (3.6)	8.2 (3.3)	8.1 (3.5)	8.3 (3.2)	0.62
# OTC medications taken, M (SD)	2.3 (1.7)	2.8 (1.9)	2.9 (2.1)	2.8 (1.8)	0.64

Three time periods were analyzed to examine 1) prevalence of medication discrepancies (at visit), and 2) rate of medication reconciliation of the discrepancies (by 2 week visit close out, 6 weeks post-visit). No differences were noted after visit between the groups, although discrepancies were high (Table 4).

Table 4. Prevalence of Medication Discrepancies and Reconciliation Activities by Study Period and Study Arm.

OUTCOME	AFTER VISIT				~ 2 WEEKS				~ 6 WEEKS			
	PRE	POST			PRE	POST			PRE	POST		
		U	I	P Value		U	I	P Value		U	I	P Value
	(N=175)	(n=69)	(n=75)		(N=175)	(n=69)	(n=75)		(N=175)	(n=69)	(n=75)	
R_x Medications												
Discrepancies, %	54.3	52.1	49.3	0.74	50.9	50.7	46.7	0.74	45.7	43.5	37.3	0.50
Reconciliation[†], %	---	---	---	---	11.6	2.8	10.8	0.36	31.6	**30.6**	**48.7**	**0.15**
Commission, %	---	---	---	---	8.5	3.3	6.3	1.0	26.8	**33.3**	**43.8**	**0.44**
Omission, %	---	---	---	---	17.7	0.0	18.2	0.20	41.2	**7.7**	**45.5**	**0.06**
OTC Medications												
Discrepancies, %	56.6	60.9	56.0	0.61	54.3	60.9	54.7	0.50	50.9	55.1	50.7	0.62
Reconciliation[‡], %	---	---	---	---	6.1	2.4	2.4	1.0	15.2	17.1	14.3	0.77
Commission, %	---	---	---	---	8.1	7.7	10.0	1.0	24.3	38.5	50.0	0.69
Omission, %	---	---	---	---	3.9	0.0	0.0	N/A	9.1	5.7	2.8	0.61

Patients receiving the MRT intervention, while not statistically significant, demonstrated trends towards greater reconciliation compared to usual care. However, this was only at the 6 week time point and not 2 weeks, and mostly for prescription medicines, and more often for commissions rather than omissions (refer to bolded, highlighted content in Table 2). In multivariable analyses accounting for study arm, medication type, and prescriber (Table 5), the MRT intervention showed non-significant trends towards having fewer discrepancies. Interestingly, a medication was significantly more likely to have a discrepancy if it were over-the-counter, and prescribed by another physician (i.e. subspecialist).

Table 5. Multivariable Analysis Examining Independent Predictors of Medication Discrepancies.

Variable	After Visit		~ 2 Weeks		~ 6 Weeks	
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Study Arm		0.38		0.33		0.27
Usual Care	---		---		---	
Intervention	1.19 (0.81 - 1.75)		1.21 (0.83 - 1.78)		1.25 (0.84 - 1.87)	
Medication Type		<0.001		<0.001		<0.001
OTC	---		---		---	
Rx	4.83 (3.69 - 6.34)		5.02 (3.82 - 6.62)		6.15 (4.57 - 8.27)	
Prescriber		<0.001		<0.001		<0.001
Other Physician	---		---		---	
Own Physician	7.77 (5.28 - 11.46)		7.95 (5.35 - 11.83)		8.26 (5.31 - 12.87)	

Analyses included N=144 patients; N=1742 medications

When examining reconciliation behaviors per medication post visit, Table 6 presents the multivariable models, allowing for each independent contribution of covariates to be isolated and shown in combination. Again, non-significant trends support the MRT intervention. And similar to discrepancies, reconciliation was less likely to occur if discrepancies were associated with medicines not prescribed by the physician, for OTC drugs, and for discrepancies that were commissions rather than omissions.

Table 6. Multivariable Analysis Examining Independent Predictors of Medication Reconciliation.

Variable	Model 1 + Medication Type		Model 2 + Prescriber		Model 3 + Discrepancy Type		Model 4 + All	
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Study Arm		0.37		0.28		0.55		0.52
Usual Care	---		---		---			
Intervention	1.38 (0.68 - 2.77)		1.48 (0.73 - 3.02)		1.24 (0.61 - 2.55)		1.27 (0.62 - 2.61)	
Medication Type		<0.001						0.15
OTC	---						---	
Rx	4.40 (2.37 - 8.17)						1.73 (0.82 - 3.70)	
Prescriber				0.002				0.89
Other Physician			---				---	
Own Physician			2.91 (1.48- 5.76)				1.05 (0.50 - 2.22)	
Discrepancy Type						<0.001		<0.001
Commission					---		---	
Omission					7.44 (3.61- 15.34)		5.05 (2.04 - 12.50)	

Analyses included N=109 patients; N=339 medications

Study 2

The primary focus of our project was to reconcile medication lists and encourage communication between providers and patients around medication use. For Study 2, our data first represents the 'proof of concept' of the use of the med sheets in primary care by running a series of pilot studies to determine feasibility. A field test was then performed, similar to Study 1, to look at preliminary communication outcomes.

Pilot Testing

Once the med sheets and UMS 'sigs' were uploaded to the identified physicians, we found that more than two-thirds of the time, this resulted in med sheets being generated with the afte-visit summary, and no physician over-wrote the UMS sig. However, we did discover small issues that required us to trouble-shoot. This included changes to physicians' known short-cuts for terms (i.e. L-i-p would previously trigger 'lipid panel', but now would call out several sigs for Lipitor). These were easily remedied.

Table 7. Characteristics of Participants, by Study Period and Arm.

Variable	Pre-Intervention	Post-Intervention			
		Total	Usual Care	Intervention	P Value
	(N=271)	(N=142)	(n=75)	(n=67)	
Age, M (SD)	50.5	52.7	53.9	51.3	0.30
Female, %	79.0	76.1	74.7	77.6	0.70
Race/Ethnicity, %					
Black	41.0	37.3	46.7	26.9	0.02
White	42.8	44.4	33.3	56.7	
Other	16.2	18.3	20.0	16.4	
Education, %					
≤ High School	17.0	18.3	25.3	10.5	0.02
Some college	28.0	22.5	25.3	19.4	
≥ College Graduate	55.0	59.2	49.4	70.1	
Literacy Level, %					
Low	3.7	5.7	9.3	1.5	<0.001
Marginal	19.2	16.3	26.7	4.6	
Adequate	77.1	78.0	64.0	93.9	
Annual Income, %					
< $15,000	21.9	21.7	30.6	12.1	0.003
$15,000-$49,999	30.3	33.4	37.5	28.8	
≥ $50,000	47.8	44.9	31.9	59.1	
# Comorbid conditions, M (SD)	1.8 (1.5)	1.9 (1.6)	2.4 (1.7)	1.4 (1.3)	<0.001
# Rx medications taken, M (SD)	4.6 (4.9)	4.5 (4.7)	5.2 (4.5)	3.8 (4.8)	0.58

Field Test

Table 7 provides the sample characteristics for the Study 2 participants. In general, no differences were noted between patients in pre vs. post-intervention periods. Patients in the intervention arm, post-intervention, were more likely to be white, higher educated, and literate.

Table 8. Prevalence of Doctor Communication about Medications by Study Period and Study Arm.

OUTCOME	Total	Study Arm		
		U	I	P Value
	(N=142)	(n=75)	(n=67)	
Did your doctor tell you…				
what this medicine is for?	97.9	98.7	97.0	0.60
what the benefit of taking this medicine is?	88.0	89.3	86.6	0.80
how long you would be taking this medicine?	65.5	61.3	70.2	0.29
about the possible side effects of this medicine	46.5	48.0	44.8	0.74
about any risks or warnings associated with this medicine?	21.1	21.3	20.9	1.0
exactly how to take this medicine?	83.8	85.3	82.1	0.65
Did you receive any written information on your new prescription today?	33.1	1.3	68.7	<0.001
Do you have questions or concerns about the medication that you weren't able to discuss with your doctor?	1.4	0.0	3.0	0.22

U = Usual Care; I = Intervention Arm

Table 8 presents preliminary outcomes analyzed around communication with providers about new medications. Overall, communication about new prescriptions, including indication and directions for use was very high. Side effect content was usually not discussed in either study arm. Two thirds of participants acknowledged receiving information for the medicines, although the intervention did not significantly address patients' questions, nor extend communication to any degree.

Study 2 Exploratory Analyses: E-Prescribing

As mentioned earlier, we assessed the effects of implementing an e-prescribing system on primary adherence in a large academic outpatient general internal medicine clinic. This was the result of NMFF GIM shifting from a printed prescription to an e-prescribing system four and a half months into the 9 month recruitment period. We interviewed adult patients who received a new prescription during their physician visit. Using their electronic health record (EHR) summary, patients were interviewed immediately following their scheduled physician visit to obtain demographic information, and assess health literacy and patient-physician communication around their newly prescribed medication. A follow-up telephone interview was conducted 7 days post-visit to obtain if and when the patient filled their medication (primary adherence) and to determine the patients' functional understanding of their new prescription. The Institutional Review Board approved this study. This internal medicine clinic shifted from a printed prescription to an e-prescribing system four and a half months into the 9 month recruitment period.

Table 9 describes the Study 2 sample, stratified by E-Prescribing period. With the exception for gender, no differences were noted by demographic variables across these phases of implementation.

Table 9. Participant Characteristics, Stratified by Recruitment Period.

Variable	Total	Pre E-Prescribing (Baseline) (n=144)	Post E-Prescribing (1-6 months) (n=127)	Post E-Prescribing (12-18 months) (n=73)	P Value
	%	%	%	%	
Age Group					0.13
< 40	25.3	31.3	21.3	20.6	
40-49	19.2	15.3	24.4	17.8	
50-59	21.2	22.9	16.5	26.0	
≥ 60	34.3	30.6	37.8	35.6	
Female	77.9	86.8	70.1	74.0	0.003
Race/Ethnicity					0.55
Black	40.7	37.5	44.9	39.7	
White	43.0	45.1	40.2	43.8	
Hispanic	5.2	6.9	2.4	6.9	
Other	11.1	10.4	12.6	9.6	
Education					0.71
≤ High School	16.3	16.0	18.1	13.7	
Some College	27.0	29.9	26.0	23.3	
≥ College Graduate	56.7	54.2	55.9	63.0	
Limited literacy	22.1	17.4	29.1	19.2	0.05
Health insurance					0.09
Private	69.1	76.4	62.2	66.7	
Medicare	14.9	11.8	20.5	11.1	
Medicaid	8.8	6.9	10.2	9.7	
None/other	7.3	4.9	7.1	12.5	
# of Rx drugs taking					0.41
1-2	38.4	43.1	34.7	35.6	
3-4	25.0	25.7	23.6	26.0	
5-6	15.1	11.1	16.5	20.6	
≥ 7	21.5	20.1	25.2	17.8	
# of chronic conditions					0.12
0	23.0	29.9	16.5	20.6	
1	22.4	20.1	25.2	21.9	
2	24.1	25.7	24.4	20.6	
≥ 3	30.5	24.3	33.9	37.0	

Table 10 presents findings on the impact of e-prescribing on primary and secondary adherence to medications, and also on multiple pharmacy use. Problems can be seen to manifest with regard to primary adherence (filling a new prescription) immediately following the implementation of e-prescribing. However, this resolves itself by a year out, to even lower rates of unfilled prescriptions than before e-prescribing. Interestingly, secondary adherence (defined as knowing what a medicine is for and how to safely administer it) was significantly poorer after e-prescribing. This might suggest less communication was provided, or that after-visit summaries are no longer used (when the old paper form might have provided clear sigs that instructed patients). Another trend approaching significance was a 50% increase rate of patients using multiple pharmacies.

Table 10. Patient Medication Adherence and Multiple Pharmacy Use, Stratified by Recruitment Period.

Outcome	Pre E-Prescribing (Baseline)	Post E-Prescribing (1-6 months)	Post E-Prescribing (12-18 months)	P value
	(n=144)*	(n=127)*	(n=73)*	
Primary Adherence				
Unfilled prescription(s)	6.9	10.6	2.5	0.07
> 1 week delay in filling prescription	12.3	8.5	6.4	0.28
Secondary Adherence				
Aware of indication	**95.4**	**97.9**	**89.8**	**0.03**
Demonstrated proper use	**69.0**	**67.1**	**51.9**	**0.02**
Multiple pharmacy use	20.0	26.5	30.1	0.23

*Each patient had a mean of 1.5 new medicines (SD 0.89)

D. DISCUSSION

Our findings, representing developmental and preliminary field testing activities, suggest:

- It is possible to leverage an EHR to prompt patients to review medication lists (MRT), and in our field test this showed signals suggesting, for the most accessible discrepancies, that our protocol prompts physicians to engage in reconciliation.
- It is also possible to shift the delivery of patient medication information upstream from pharmacy to primary care setting, by linking clear, understandable and tangible print tools (Med Sheets) to mapped 'sigs' and have this as an automated process.
- It is also possible to populate an EHR with standardized sigs to limit variability and the use of poor quality or confusing instructions for medicines. We found this worked 100% of the time, as default sigs in the system were never changed during our field test.

However, there are several lessons learned to guide future improvements:

- For reconciliation, medication discrepancies were less likely to be addressed by the physicians if 1) they did not prescribe it, 2) it was an OTC medicine, 3) it was an omission, and 4) it was a symptom-directed drug vs. a medicine for a chronic condition.

- Also, our intervention did not improve rates of reconciliation at the actual medical encounter. Rather, it took up to 6 weeks to see discrepancies removed. From speaking with numerous physicians in the study, the common root cause for this was not perceiving there be time (nor being required to fix the medication list) during the encounter. MRT sheets would be stockpiled for later review. The result is that patients checked out after the encounter leaving with an after-visit summary that did not have an updated medication list.

- For the Med Sheets, while it was feasible to provide this material to patients, it is unclear in our field test whether this truly benefited patients. Part of the reason is that the rate of counseling was atypically high in the NMFF GIM clinic, and finding improvement would be difficult in with larger samples. Yet an additional feature that was initially discussed was the linking of the Med Sheets (a PDF in the EHR file) to a 'dot phrase' (e.g. ".Lipitor <ENTER>). This would provide decision support for the physician, although it was unanimously voted down at an NMFF business meeting. The concerns were that such a dormant function would not be used. As our preliminary data suggests in Table 10, our intervention ensured patients were given information as they left the clinic, but did not change what doctors discussed during encounters.

E. CONCLUSION

Our findings were not meant to be definitive, but to offer a 'proof-of-concept' via feasibility assessments, and assessment of the efficacy of these tools to improve medication understanding, use, and decision making for both patients and providers. Clearly, what we designed was a feasible strategy that could be an efficient and sustainable means for reconciliation and education. However, the effectiveness was limited, as we attempted to make the intervention patient-initiated rather than risk practice re-design considerations that could be detrimental to any sustainable effort.

But that might be the primary limitation – physicians and clinic staff were not asked to change their routine, nor to attach any further salience to medication reconciliation and patient counseling for new medicines. Instead we automated these activities and attempted to create teachable moments and interactions through tangible signals (i.e. patient coming to an encounter with a completed MRT; generation of the Med Sheet with the order) that would prompt providers to engage in reconciliation or education. E-prescribing directly impacted the latter. Where previously a physician would generate an order and leave the exam room to physically pick up the print out to hand to patient, this step was eliminated and no tangible prompt around a new medicine was given to the patient by the provider.

A future iteration of the study should not do away with the notion of using the EHR in the manner that we describe, but find more robust means to either require more timely reconciliation (at the same visit), and to pair education materials with a counseling encounter (e.g. nurse, pharmacist) to both perform a comprehensive medication review and discuss any new prescriptions.

F. PRODUCT/PUBLICATIONS

Manuscripts:

Webb JR, Feinglass J, Makoul G, Wilkes CL, Dunham DP, Baker DW, Wolf MS. Can electronic health records help improve patients' understanding of medications? Am J Manag Care 2010;16: 919-22.

In preparation/under review

Bergeron A, Webb JR, Shrank WH, Curtis LM, Persell SD, Makoul G, Wolf MS. Local perspective of the impact of E-prescribing on medication adherence. *Med Care 2012*

Wolf MS, Bergeron A, Curtis LM, King J, Persell SD, Baker DW, Makoul G., Feinglass J, Dunham D, Bailey SC, Wolf MS. Leveraging an electronic health record for medication reconciliation: a controlled trial. *Ann Intern Med 2012*

Bailey SC, Persell SD, Bergeron A, Curtis LM, Feinglass J, Baker DW, Makoul G., Wolf MS. Shifting upstream: providing patient medication information at prescribing via electronic health records. *J Gen Intern Med 2012.*

Presentations:

1. Webb J and Wolf MS. Local perspective on the impact of E-prescribing on medication use and adherence. *Presented at the 3rd Health Literacy Annual Research Conference (HARC) national meeting, Chicago, IL, October 2011.*
2. Webb J, Makoul G, Baker DW, Marcello K, Feinglass J, Wolf MS. A Medication reconciliation and education strategy (NUMed) for ambulatory care. *Presented at the1st annual national meeting for health literacy research conference, Washington DC, October 2009.*
3. Webb J, Makoul G, Baker DW, Marcello K, Feinglass J, Wolf MS. Medication reconciliation via electronic health record in ambulatory care. *Presented at the Society for General Internal Medicine, Miami, FL, April 2009.*
4. Wolf, M.S. and Makoul, G. Improving consumer medication information materials. *Workshop at the International Conference on Communication in Healthcare, Oslo, Norway; September 2, 2008.*
5. Wolf, M.S. Getting rid of Latin: Using the electronic record to generate consumer medication information. *Oral presentation at the International Conference for Healthcare Ergonomics and Patient Safety, Strasbourg, France; June 29, 2008.*

Future Grants:

1. 1R01NR012745 - 01 (Persell) 4/1/11 - 3/31/16 NINR
   EHR-based Health Literacy Strategy to Promote Medication Therapy Management
2. U19 HS021093-01 (Lambert) 9/15/11 - 9/14/16 AHRQ
   An EHR-based Strategy to Promote Safe and Appropriate Drug Use